
# INTERNATIONAL PRICES AND CONTINUING CONFLICT THEORY AND EVIDENCE FROM SUB-SAHARAN AFRICA (1980-2017)

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# INTERNATIONAL PRICES AND CONTINUING CONFLICT
# THEORY AND EVIDENCE FROM SUB-SAHARAN AFRICA (1980-2017)

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## Abstract

*This paper presents first a theoretical model of conflict between two parties in a two-sector economy. In a 'contested' sector, they struggle to appropriate the maximum possible fraction of a contestable output. In an 'uncontested' sector, they hold secure property rights over the production of some goods. Parties split their resource endowment between 'butter', 'guns' (in the contested sector) and 'ice cream' (in the uncontested sector). The model predicts that the level of guns depends positively on the relative price of goods produced in contested and those produced in the uncontested sector. As the relative price decreases actors decrease their outlays in 'guns'. The empirical section is focused on a panel of Sub-Saharan African countries for the period 1980-2017. Results show that international prices of manufactures (interpreted as the uncontested ice-cream sector) are negatively associated with arms imports and military expenditure so confirming the theoretical prediction. The results appear to be robust. In addition, we have checked whether world prices have an impact on the probability of an armed conflict. We found that internal and internationalised civil conflicts react differently to world prices.*

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*Jel Classification:* D74, O13, H56

## Introduction

The purpose of this paper is twofold. On one hand, this paper is intended to enrich the theoretical economic analysis of conflicts. On the other hand, it is intended to contribute to the literature on both military expenditures and civil wars in Sub-Saharan Africa by pointing out the relationship between commodities, manufacturing, arms import and military expenditures and eventually the incidence of actual violent conflicts.

This paper complements the theoretical literature of conflict based upon Hirshleifer (1988) and eventually surveyed in Garfinkel and Skaperdas (2007)[1]. In particular, the theoretical model presented hereafter is an extension of a baseline model presented in Caruso (2010). It considers an economy characterized by two sectors. In a first sector - the uncontested sector - each party holds secure property rights over the production of some goods. In the second sector- the contested sector - agents fight in order to appropriate the maximum possible fraction of a contestable output. The conflict also determines the allocation of available resources and the distribution of income and power. With a contested-uncontested distinction, there are three possible allocations of resources, here termed (i) guns, (ii) butter, and (iii) ice cream. Butter and guns denote the classical trade-off between production and appropriation under the assumption that 'butter' includes the productive activities which are under the threat of appropriation. Ice cream denotes all the productive activities which are not under threat of appropriation. In other words, ice cream denotes all the productive activities that are not directly affected by the existence of an armed conflict. Needless to say, the opportunity cost of conflict would be related not only to the contested production but also to the production of goods which are not subject to appropriation. Production of both goods

[1] See among others, Grossman (1991), Skaperdas (1992), Grossman and Kim (1995), Skaperdas and Syropoulos (1996), Anderton et al.(1999), Baker (2003), Bös and Kolmar (2003), Maxwell and Reuveny (2005), Caruso (2006/2007), Hausken (2004/2006), Munster (2007).

would eventually also depend on the relative price of butter in terms of ice cream. The acquisition of 'guns' also would depend on that. Assuming that both parties can be considered as small open economies which face world prices of both commodities and manufactured goods, the model highlights how world prices affect the level of guns in the economy[2].

Empirically the level of guns can be captured alternatively through arms imports and military expenditures. Therefore, in the second part of the paper, we present an empirical application to the Sub-Saharan Africa for the period 1980-2017. First we test whether there is an association between world prices of some commodities and manufactured goods and arms imports and military expenditures. Results show that international prices of manufactured goods are negatively associated with arms import and military expenditure so confirming the theoretical prediction. Eventually, for sake of robustness we focus on agriculture by including the agricultural raw price, instead of the MUV index, in order to see its association on military expenditures, the acquisition of arms, internal and internationalized conflicts. Results are alike.

Eventually we also test whether the same prices are to be associated with incidence of civil wars. On civil wars, there is a widespread agreement that the incidence of civil wars is positively associated with the abundance of natural resources and also with commodity prices. Our results show that there is a significant difference between internal and internationalized conflict as defined in the UCDP/Prio dataset with respect to the hypothesis of this work. In particular, it appears that only the incidence of internationalized conflicts is to be associated positively with commodity prices and negatively with world prices of manufactured goods.

[2] Among Hirshleifer-style models there are few which address directly the impact of world prices on the intensity and dynamic of conflict. Only Garfinkel, Skaperdas and Syropoulos (2008) model a conflict over a tradable natural resource [say Oil] whose exploitation is contested by different domestic groups. The authors model and compare autarky and free trade scenarios highlighting that under free trade for a wide range of prices, an increase of international price of the contested resource fuels conflict.

In sum, this paper aims to contribute to three strands of literature: the theoretical modelling of conflict, the empirical evidence on arms imports and military expenditures and the incidence of civil armed conflicts in Sub-Saharan Africa. The paper is structured as follows: first we present a survey of the related literature. Eventually a formal model is presented. Eventually, on the basis of the theoretical analysis, an empirical application to the emergence of civil wars, military expenditures and the acquisition of arms in Sub-Saharan Africa is presented. Conclusions summarise the results.

## I. Review of literature

Within a large empirical literature on economics causes of civil wars[3], there are studies which focus punctually on relationship between actual conflicts and commodity prices. Ciccone (2018) examines the relationship between international commodity prices and civil conflicts by computing commodity price shocks using time-invariant (fixed) export shares as commodity weights. Empirical evidence suggests that a decrease in such prices boost civil wars in Sub-Saharan Africa, since 1980. Gimenez and Zergawu (2018) study the effect of shocks in prices of commodity exports on conflict incidence and the impact of fractionalization, ethnic and religious polarization on political instability. Using a large sample panel data, over the period of 1970–2014, they find out that commodity export price shocks are positively related to conflicts in ethnically polarized societies. However, such effect depends on the type of income shocks and category of commodity, in ethnically and religiously fractionalized societies. Berman and Couttenier (2015) make an empirical analysis about the effect of external income shocks on civil conflicts for the 1989–2006 period. In order to do so, they use georeferenced information on the location of violent events in sub-Saharan

[3]See among others: Collier and Hoeffler (1998/2000/2004), Le Billon (2001a), De Soysa (2002), Sambanis (2001/2002), Bannon and Collier (2003), Fearon and Laitin (2003), Fearon (2005), Humphreys (2005), Lujala et al. (2005), De Soysa and Neumayer (2007), Collier and Goderis (2008).

African countries. They find that changes in income affect negatively to the incidence, intensity, and onset of conflicts. Bazzi and Blattman (2014) test the relationship between economic shocks and conflict, using data on export price shocks, for the 1957-2007 period. They conclude that price shocks do not generate new conflicts, even in countries where the risk of conflicts is high. However, they determine that rising prices are related to shorter and less intense wars. Denly et al. (2019) examine the variation of conflict incidence with the value of the collective set of resources in a given location using world prices. They use a new sub-national dataset of 183 resources that adds many resource types, locations, countries, and local price data from Africa, the Middle East, Asia and Latin America. Empirical evidence proves the positive relationship between subnational resource wealth and conflict levels.

Bhattacharyya and Mamo (2019) propose a quasi-natural experiment in order to study the relationship between natural resources (oilfield and mineral discoveries) and intra-state armed conflicts in Africa, using a geocoded dataset. They do not find empirical evidence of resource discoveries as determinants of conflicts. This result contradict their intuition that resource discoveries reduce conflict. The relationship remains unchanged at regional and national levels. Besley and Persson (2008) show how both export and import price indexes for commodities are positively and significantly correlated with the incidence of civil war. In particular, disentangling agricultural and minerals, the authors found that agricultural export and import prices are positively and significantly associated with the incidence of a civil war. Instead, only mineral import prices are significantly and positively associated with the incidence of a civil war whereas the mineral price index shows no significant correlation. Interestingly, there is no significant association between oil export price and the incidence of a civil war. Bruckner and Ciccone (2010) found that there is a significant negative association between international commodity prices and the onset of civil wars. In particular, the authors show that civil war onset in year $t$ is

negatively associated with the growth of international commodity prices over the 3 previous years. Angrist and Kugler (2008) study the relationship between coca prices, income and civil conflict in Colombia. In particular, the authors analyse the impact of the consequences of an abrupt rise in coca prices upon violence. The empirical strategy is a logit estimation whose dependent variable is the ratio of violent deaths upon the population. The findings show increased violent death rates after the increase in coca cultivation associated with a rise in price of Colombian coca. Another interesting paper is about Columbian conflict, is by Dube and Vargas (2013) that explore how international commodity prices shocks affect armed conflict in Colombia. The authors found that exogenous price shocks in the coffee and oil markets have significant effects on armed conflict in Colombia. A severe fall in coffee prices in the late 1990s increased dramatically the level of violence in coffee-intensive municipalities, by lowering wages and therefore the opportunity cost of recruitment into armed groups. By contrast, a rise in oil prices increased conflict in the oil region, by raising potential gains from its exploitation. That is, the higher the oil world price the higher is the bloody rent-seeking associated with it. There are other studies which focus on the effect of commodity prices on military expenditures and acquisition of arms. Seiglie (2016) presents a theoretical model that explores the determinants of a country's level of military spending. The paper makes use of Cobb-Douglas utility functions in order to compute the Nash equilibrium allocations of two commodities in an economy, wheat and steel. Empirical evidence for the 1968-1978 period suggests that greater gains from trade can lead to greater military expenditures to protect them. Seiglie (2016) also finds that expansion in the demand for a country's tradable commodities has an effect on defense expenditures.

Commodity price shocks have a significant effect on the economic growth of countries. Harvey et al. (2018) test the trend in relative commodity prices and its implications for many developing country growth rates. In order to

do so, they create ultra- long aggregate series shaped by common factors. Harvey et al. (2018) find that series present a downward trend divided in 4 regimes of predominantly increasing decline: 1650-1820, 1821-1872, 1873-1946 and 1947- 2010. Finally, they suggest that the trend in economic activity can be used as a proxy for factors like technology and show a negative relationship between trends in commodity prices and World GDP. Musayev (2014) analyses the relationships between resource windfalls, political regimes, conflict and economic growth. Musayev (2014) uses panel estimation methods in order to study such relationships, along a specific measurement of the commodity price shock. The paper shows that resource windfalls have significant impact on conflict only in politically unstable autocracies. Musayev (2014) also finds that resource shocks affect positively to the economic situation of democracies and politically stable autocracies, while significantly deteriorates the growth for politically unstable autocracies.

## II. A model of conflict and production

The following model extends Caruso (2010) which considers an economy characterized by two sectors. In a first sector - the uncontested sector - each party holds secure property rights over the production of some goods. In the second sector- the contested sector - agents fight in order to appropriate the maximum possible fraction of a contestable output. With a contested-uncontested distinction, there are three possible allocations of resources, here termed (i) guns, (ii) butter, and (iii) ice cream. Butter and guns denote the classical trade-off between production and appropriation under the assumption that 'butter' includes the productive activities which are under the threat of appropriation. Ice cream denotes all the productive activities which are not under threat of appropriation. In other words, ice cream denotes all the productive activities that are not directly affected by the existence of an armed conflict. In the current paper we consider two risk-neutral actors indexed by $i = 1,2$. These actors can be interpreted as two

polities and they are assumed to be unitary actors. They both produce two goods (butter and ice cream) which are to be sold to the rest of the world. That is, the world is made of polity 1, polity 2 and the rest of the world. Both polities have a positive resources endowment denoted by $R_i \epsilon (0, \infty), i = 1,2$. The positive resources endowment can be divided into 'guns', 'butter' and 'ice cream'. By 'guns' we indicate any positive outlay in unproductive activities of fighting. By 'butter' we indicate any positive investment in productive activities in the contested sector, whilst by 'ice cream' we indicate any positive investments in productive activities in the uncontested sector. In fact, in the presence of a continuing conflict the two polities allocate a fraction of their resources endowment to unproductive activities of fighting (for appropriation). It is assumed that only one good (say the butter) is contested, namely subject to appropriation. Uncontested production of ice cream is secure from appropriation. Henceforth, we also shall refer to them as 'contested' and 'uncontested' sectors respectively. For sake of simplicity, henceforth we shall use indistinguishably butter, guns and ice cream to indicate both input and output of production processes. The two polities interact simultaneously so generating a Nash-equilibrium allocation of resources endowment to 'guns', 'butter' and 'ice cream'. In particular, polities observe an exogenous price for both butter and ice cream and therefore they move simultaneously and choose an optimal level of guns and ice cream. So the supply of both butter and guns is determined. In sum it is possible to write the resources constraint as:

$$R_i = y_i + x_i + G_i, i = 1,2 \qquad (1)$$

where $G_i$ denotes the level of 'guns', and $y$ and $x$ denote 'ice cream' and 'butter' respectively. They are all assumed to be positive: $G_i \in (0, \infty), y_i \in (0, \infty), x_i \in (0, \infty), i = 1,2$. In the contested sector, the contested joint product – indicated by $CY$- can be described as a simple linear additive function:

$$CY = x_1 + x_2 = TR - G_1 - y_1 - G_2 - y_2 \quad (2)$$

Where $TR = R_1 + R_2$. This aggregate production function is characterized by constant returns to scale and constant elasticity of substitution. The outcome is determined by means of an ordinary Contest Success Function[4] (henceforth CSF for brevity) in its ratio form:

$$q_i(G_1, G_2) = \frac{G_i}{(G_1+G_2)}, i = 1,2 \quad (3)$$

The functional form adopted for CSF is a special case of the general ratio form of CSF. The CSF is differentiable and follows the conditions below:

$$\begin{cases} q_1 + q_2 = 1\ ;\ q_i = .5\ at\ G_1 = G_2 \\ \partial q_i/\partial G_i > 0 \quad \partial q_i/\partial G_j < 0 \\ \partial^2 q_i/\partial G_i < 0 \quad \partial^2 q_i/\partial G_j > 0 \end{cases}$$

The outcome in the contested sector is given by:

$$S_i = q_i(G_1, G_2)CY \quad (4)$$

The uncontested sector is modelled as a traditional sector exhibiting decreasing returns to scale. Therefore, the production function is a standard intensive production function which exhibits decreasing returns to scale:

$$Y_1(y_1) = y_1^s, Y_2(y_2) = y_2^s \quad (5)$$

where $y_i$ denotes the level of resources devoted to the uncontested production by polity $i$ and $s\epsilon(0,1)$ is the parameter capturing the degree of

[4]Selective seminal contributions on CSF are by Tullock (1980), O'Keeffe et al. (1984), Rosen (1986), Dixit (1987) and Hirshleifer (1989). See then Skaperdas (1996) and Clark and Riis (1998) for a basic axiomatization.

returns of scale. For sake of simplicity polities are assumed to be equally productive. Eventually, final income of each polity can be described as:

$$W_i(Y_i, S_i) = Y_i + pS_i, i = 1,2 \quad (6)$$

With $p = \bar{p}_b/\bar{p}_{ice}$ denoting the initial relative price of butter ($\bar{p}_b$) in terms of ice cream ($\bar{p}_{ice}$) . That is, polities observe exogenous prices $(\bar{p}_b, \bar{p}_{ice})$. Polities are assumed to be rational and to interact simultaneously à la Nash-Cournot. Therefore, treating the opponent's choice as given each region $i$ maximizes (6) with respect to $G_i$ and $y_i$. Under an ordinary process of maximization the Nash equilibrium choices of 'ice cream' are:

$$y^* = y_1^* = y_2^* = \left(\frac{p}{2s}\right)^{1/(s-1)} \quad (7)$$

It is clear that $\partial y_i^* / \partial p < 0$ , namely the higher is the initial relative price of butter in terms of ice cream, the smaller will be the production of ice cream. In particular, the supply of ice cream increases in the degree of productivity only in the presence of a combination of $p$ and $s$, $\partial y_i^* / \partial s > 0 \Leftrightarrow p < 2se^{1/(s-1)}$. That is, when $p$ is high enough, it can dominate the positive impact on production emerging in the presence of an adequate degree of productivity. The level of guns in equilibrium is given by:

$$G_1^* = G_2^* = G^* = \frac{TR}{4} - 2^{s/(1-s)}\left(\frac{p}{s}\right)^{1/(s-1)} \quad (8)$$

Clearly the optimal level of guns is increasing in the initial relative price of butter in terms of ice cream, namely $\partial G^*/\partial p > 0, \partial G^*/\partial\partial p > 0$. Eventually, the level of butter is given by:

$$x_1^* = R_1 - y_1^* - G_1^* = \left((3R_1 - R_2)/4\right) - 2^{s/(1-s)}(p/s)^{1/(s-1)} \quad (9.1)$$

$$x_2^* = R_2 - y_2^* - G_2^* = -2^{s/(1-s)}(p/s)^{1/(s-1)} - \left((R_1 - 3R_2)/4\right) \quad (9.2)$$

Where $\partial x_1^*/\partial p > 0$ and $\partial x_2^*/\partial p > 0$. That is, reasonably the quantity of butter is increasing in the initial relative price of butter in terms of ice cream. Evidently, given that $G^* = G_1^* = G_2^*$ and $y^* = y_1^* = y_2^*$, hence $x_1^* \neq x_2^* \Leftrightarrow R_1 \neq R_2$.

In sum, this simple model shows that the optimal level of guns depends positively on the world relative price of butter and ice-cream. As the relative price increases, the incentives for fighting increase and actors increase their expenditures in 'guns', so eventually inflaming the conflict. Consequently, the investments in uncontested sectors would decrease in the world price of contested commodities. In fact, the main prediction of the model is that the level of guns depends on the relative price between butter and ice-cream. Needless to say, whenever the price of butter exceeds the price of ice-cream both polities have incentives to increase the level of guns.

## III. Data and empirical implications

The theoretical analysis suggested that the relative price of commodities of contested sectors in terms of goods produced in the uncontested sector has a role in explaining the intensity of destructive activities undertaken by states. In other words, the level of 'guns' within an economy can be directly linked to the world prices of goods and commodities. In order to verify whether the theoretical predictions can be validated hereafter we propose an empirical application focused on Sub-Saharan Africa for the period 1980-2017.

As noted above there is an established literature which uncovered the relationship between the exploitation of primary commodities and the incidence of civil wars. In our perspective exploitation of primary commodities and resources fall within the category of 'contested' sectors whereas manufacturing sector presumably can be assumed to constitute

the portion of economic activity which can be modeled as ice-cream, namely the uncontested production. In fact, the producers are likely to supply more when the prices are high in order to increase expected revenues. Choices of producers of contested commodities are based on world prices. Therefore, a reasonable empirical application must consider the ratio between a commodity price index and a manufactures price index. Commodity prices indexes are computed on a regular basis by IMF. The benchmark manufactures price index is the Manufactures Unit Value Index (henceforth MUV). It is a trade-weighted index of the fifteen major developed countries' exports of manufactured goods to developing and emerging countries. The MUV is the only readily available trade-based manufacturing price measure available over a long time horizon. In fact, it has been commonly used as a measure of developing country imports. Its use in the present context is based on the rather strong assumption that manufacturing exports of the fifteen major developed countries can be considered as a representative benchmark for the manufacturing exports of the rest of the world, especially of developing countries. In this perspective, the MUV can be considered representative for world price of manufactures. This assumption can be reasonable when considering that (i) economic integration occurred in the latest years induced also a convergence of prices of like goods; (ii) the 'geography of trade' has been re-shaping in the latest fifteen years. First, almost half of global manufacturing exports (47% in 2015) come from developing and emerging economies. Secondly a dramatic increase of South-South also trade took place [see Horner and Nadvi (2017)]. In the latest years, in particular, the rising weight of China in world trade of manufactures which put a remarkable pressure on international prices towards convergence. Shortly, China's rapid technological progress, low labour costs and economies of scale have put a downward pressure on prices of manufactured goods. For example Kaplinsky (2006) explains that within a significant number of product groups, the prices of products exported into the EU by China and low-income economies was more likely to decline than

the prices of the same products-groupings sourced from other high-income economies. This is because of the intense competition between China and low-income countries. Villoria (2009) also finds, that China has significantly decreased world prices in major markets for manufactures, especially textiles, wearing apparel and footwear, potentially displacing the clothing exports of African countries. As a consequence of China's export growth, less-developed countries have also experienced substantial reductions in both their import and exports prices across all manufacturing sectors. Fu, Kaplinsky and Zhang (2009) show that China's exports have influenced not only prices of low-skilled and labour-intensive exporters but also prices of exports originating from high and middle-income countries. That is, under the emerging convergence of world prices for many categories manufactures, we henceforth assume that the MUV index can be used as world price of manufactures index.

Therefore, we are able to validate the theoretical model by employing both commodity prices and MUV. In fact, we can verify whether level of 'guns' is related to both. In particular, we would employ alternatively 'arms imports' and 'military expenditures' as measures of 'guns'. Then, we have created a panel dataset for the acquisition of arms, for military expenditures and the occurrence of civil wars in Sub-Saharan Africa, which spans from 1980 to 2017. Table 1 shows that Sub-Saharan African countries have, on average, 450.17 million dollars of military expenditures while they spend, on average, 50.42 million dollars on the acquisition of arms. However, as the minimum and maximum values show, there are remarkable differences between countries. Therefore, we also analyze the logarithms of our dependent variables.[5]

Table 1: Descriptive statistics of dependent variables

| Variable | Obs | Mean | Std. Dev | Min | Max | Source of data |
|---|---|---|---|---|---|---|
| Milex | 985 | 450.17 | 960.79 | 1.2 | 7741 | SIPRI Military Expenditure Database |

[5] Descriptive statistics of control variables are shown in Appendix.

| | | | | | | |
|---|---|---|---|---|---|---|
| armsimport | 1015 | 50.42 | 115.01 | 0 | 1246 | SIPRI Arms Transfers Database |
| lnmilex | 985 | 5.001 | 1.46 | 0.18 | 8.95 | SIPRI Military Expenditure Database |
| lnarmsimport | 973 | 2.63 | 1.66 | 0 | 7.13 | SIPRI Arms Transfers Database |

Figure 1 shows the histogram of the logarithm of military expenditures. We take into account that the mean value of the logarithm is equal to five.

We observe that the greatest proportion of countries spend, more or less, the average value of military expenditures, while a very small proportion spends values close to zero.

In contrast, some countries represent the highest values of military expenditures.

Figure 1: Distribution of military expenditures (in logarithm)

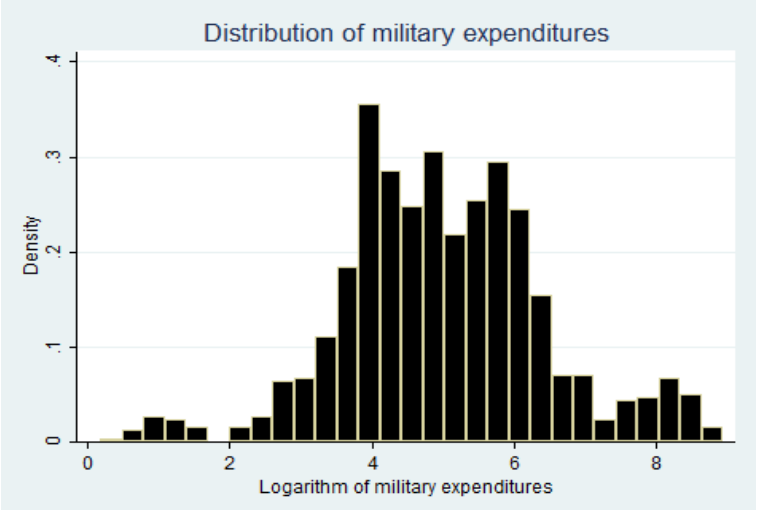
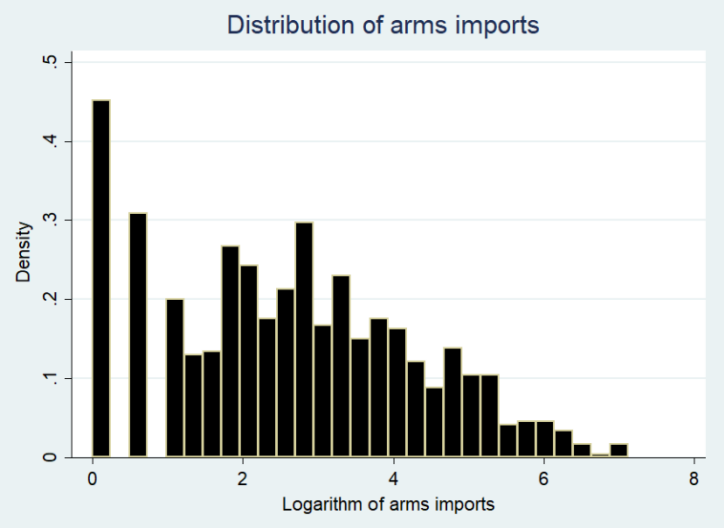



Figure 2 shows the histogram of the logarithm of arms imports. We point out that the average of the logarithm of arms imports equals 2.63. We also observe that a remarkable proportion of countries do not import arms. The greatest proportion of countries spend, more or less, the average value of arms imports.

Figure 2: Distribution of arms imports (in logarithms)




## IV. Arms Imports and Military Expenditures

In what follows we estimate the impact of world prices on arms imports and military expenditures. Therefore, we estimate the following fixed effects panel OLS model:

$$milex_{it} = \beta_0 + \beta_1 commodity_{ikt-1} + \beta_2 MUV_{t-1} + \beta_3 Manufactures_{it-1} + X_{it} + u_{it}$$

where *Milex* denotes alternatively arms imports and military expenditures. The commodities indexes considered are alternatively: (i) an Oil price index; (ii) the Commodity Nonfuel Price Index; (iii) a metals price index. Source for these indexes is the IMF database. In particular, annual averages have been computed on the basis of monthly averages. The MUV index and the

Manufactures exports are available on the World Bank website[6]. We use lagged values for all indexes mentioned above. Eventually, in order to take into account the whole economic structure of the economy we include both the manufacturing and agricultural share of GDP as in Caruso (2010). The interaction between the MUV index and the manufactures exports is added in order to see its effect on arms imports and military expenditures. Finally, we are also including some covariates drawn from existing literature on civil conflict. In particular, we are including: (i) the degree of openness, (ii) the population, (iii) the polity score (as developed in the Polity IV project) and a dummy variable capturing whether a country is an oil exporter or not, and finally whether a country is landlocked or not. Table 16 in Appendix shows the summary statistics and the sources of every variable included in our estimations. Deciles of income by countries, in terms of real GDP per capita in 2000, are added in Table 17 in Appendix. We have chosen this year because the mean value of real GDP per capita is the closest to the mean value of this variable in the 1980-2017 interval. Table 2 reports the results. For sake of brevity, coefficients of control variables and constants are not displayed.

Table 2 – Arms import, Military expenditures and international prices

| | Arms import | | | Military Expenditures | | |
|---|---|---|---|---|---|---|
| (Log) OIL price index Lagged | .437** | | | .187* | | |
| | (.173) | | | (.099) | | |
| (Log) Non fuel price index Lagged | | 1.422** | | | .646** | |
| | | (.456) | | | (.252) | |
| (Log) metals price index Lagged | | | .772*** | | | .283*** |
| | | | (.212) | | | (.101) |
| (Log) MUV Lagged | 1.426* | -.404 | -.548 | .013 | -.791 | -.381 |
| | (.775) | (.931) | (.923) | (.839) | (.633) | (.752) |
| (Log) Manufacture Exports (millions) Lagged | 1.503** | 1.436* | 1.052 | .504 | .523 | .406 |
| | (.719) | (.735) | (.635) | (.825) | (.815) | (.792) |
| MUV * Manufacture Exports Lagged | -.346** | -.339** | -.246* | -.099 | -.107 | -.080 |

[6] The MUV is available at http://go.worldbank.org/VDQ5AA3VP0 [accessed on november 2019].

| | | | | | | |
|---|---|---|---|---|---|---|
| | (.161) | (.167) | (.144) | (.180) | (.179) | (.173) |
| (Log) Agricultural Share of GDP | -.242 | -.283 | -.267 | -.258 | -.287* | -.276* |
| | (.297) | (.291) | (.296) | (.163) | (.157) | (.155) |
| Controls and constant | YES | YES | YES | YES | YES | YES |
| Obs. | 633 | 633 | 633 | 878 | 878 | 878 |
| Groups | 37 | 37 | 37 | 37 | 37 | 37 |
| R-sq within | .0343 | .0371 | .036 | .4605 | .4665 | .4677 |
| R-sq between | .2300 | .1518 | .188 | .4660 | .4160 | .4188 |
| R-sq overall | .0605 | .0233 | .0354 | .5149 | .4641 | .4677 |

Notes: standard errors in parenthesis, * **significant at 1%, ** significant al 5%, *significant at 10%.

Table 2 above reports the results. In this case, a positive association between the different measures of commodity prices and the dependent variables is clear-cut. Perhaps, results show that commodity prices are positively associated with military expenditures. By contrast, there is a weak negative association between the agricultural share of the GDP and military expenditures. The coefficients associated with MUV and the manufacture exports are statistically insignificant in many estimations. However, as these two variables are interacted with each other, we need to compute the marginal effects in order to see the relationship between these variables and dependent variables (see table 3).

Table 3 – Marginal effects of Table 2

| | Arms import | | | Military Expenditures | | |
|---|---|---|---|---|---|---|
| (Log) MUV [(Log) manuf. (20th percentile)] | .405 | -1.404 | -1.273* | -.271 | -1.098*** | -.611* |
| | (.547) | (.884) | (.769) | (.385) | (.356) | (.353) |
| (Log) MUV [(Log) manuf. (40th percentile)] | -.147 | -1.944** | -1.665** | -.389 | -1.224*** | -.705** |
| | (.570) | (.968) | (.775) | (.269) | (.408) | (.292) |
| (Log) MUV [(Log) manuf. (60th percentile)] | -.388 | -2.180** | -1.837** | -.494* | -1.337** | -.790** |
| | (.614) | (1.025) | (.799) | (.283) | (.527) | (.347) |
| (Log) MUV [(Log) manuf. (80th percentile)] | -.711 | -2.497** | -2.066** | -.582 | -1.432** | -.861* |
| | (.698) | (1.116) | (.848) | (.378) | (.653) | (.449) |
| (Log) Manufacture Exports (millions) | -.075 | -.109 | -.069 | .044 | .027 | .035 |
| | (.109) | (.110) | (.112) | (.074) | (.075) | (.073) |

Notes: standard errors in parenthesis, ***significant at 1%, ** significant al 5%, *significant at 10%.

Table 3 shows the marginal effects of the MUV index and the manufacture exports variables in Table 2. We have computed the marginal effect of the MUV index by the percentile of the logarithm of manufacture exports. By doing so, we distinguish between countries with very low exports, like Burundi and Sierra Leone; exports close to the mean, like Malawi and Ethiopia, and countries with very high exports, like Nigeria and South Africa.

We can observe that a 1% increase in the MUV index has a negative effect on both arms imports and the military expenditures. In fact, the effect of the increase of MUV on arms imports and military expenditures is even more negative in countries with greater manufacture exports, like Nigeria and South Africa. In countries like these, a 1% increase in the MUV index generates approximately a 2% decrease in arms imports and a 1% decrease in military expenditures. Meanwhile, in countries with low exports, the 1% increase in the MUV index generates approximately a 1% decrease in both arms imports and military expenditures. This result completely fits the theoretical model. Therefore, there is evidence on the negative impact of international price of manufactures on military expenditures and acquisition of arms. In other words, as the price of manufacturers increase the arms imports and military expenditures appear to decrease. In sum, in this section it is possible to highlight that military expenditures and arms imports are positively associated with commodity prices and negatively associated with the international price of manufactures. This confirms the theoretical prediction expounded above.

## V. Incidence of Civil Wars

In the previous section, we have highlighted whether arms imports or military expenditures are directly affected by the international prices or not. However, it could be suggested that the predictions of the theoretical model does not apply only to the acquisition of military power, namely the guns of

the theoretical model expounded above, but rather to the existence of an actual conflict. Eventually we estimate the following random effects panel probit model:

$$civilwar_{it} = \beta_0 + \beta_1 commodity_{ikt-1} + \beta_2 MUV_{it-1} + X_{it} + u_{it}$$

The incidence of a civil war has been captured through a dummy variable (*civilwar*) which takes the value of unity in the presence of a civil war in country *i* at time *t* and zero otherwise. Data about civil wars have been drawn from UCDP/Prio Database[7]. We take into consideration alternatively two types of conflict coded by UCDP; (a) Internal armed conflict that occurs between the government of a state and one or more internal opposition group(s) without intervention from other states; (b) the Internationalized internal armed conflict that occurs between the government of a state and one or more internal opposition group(s) with intervention from other states (secondary parties) on one or both sides. Disentangling between different types of conflict is functional to study whether different types of conflict exhibit different economic correlates.

Table 4– Conflict and international prices – Main results

| | Internal Conflict | | | Internationalized conflict | | |
|---|---|---|---|---|---|---|
| (Log) OIL price index Lagged | -.620*** | | | .536*** | | |
| | (.125) | | | (.193) | | |
| (Log) Non fuel price index Lagged | | -2.378*** | | | 1.986*** | |
| | | (.426) | | | (.602) | |
| (Log) metals price index Lagged | | | -1.355*** | | | .626* |
| | | | (.235) | | | (.329) |
| (Log) MUV Lagged | 2.385*** | 5.053*** | 5.040*** | -4.295*** | -5.708*** | -5.526*** |
| | (1.032) | (1.152) | (1.126) | (1.300) | (1.432) | (1.463) |
| (Log) Manufacture Exports Lagged (millions) | 2.818*** | 3.281*** | 3.277*** | -4.981*** | -5.799*** | -6.720*** |
| | (1.026) | (1.107) | (1.073) | (1.361) | (1.529) | (1.496) |

[7] The dataset is available at www.ucdp.uu.se

| | | | | | | |
|---|---|---|---|---|---|---|
| MUV * Manufacture Exports Lagged | -.642*** | -.730*** | -.736*** | 1.040 | 1.206*** | 1.428*** |
| | (.224) | (.242) | (.234) | (.296) | (.332) | (.323) |
| (Log) Agricultural Share of GDP | .287 | .393* | .326 | .194 | .146 | .241 |
| | (.218) | (.224) | (.220) | (.290) | (.303) | (.300) |
| Oil exporter (dummy) | -2.891*** | -9.485*** | -4.821*** | 4.390*** | 12.468*** | 7.869*** |
| | (.831) | (2.336) | (1.286) | (1.154) | (3.166) | (1.836) |
| Commodity Price Lagged * Oil exporter | .778*** | 2.119*** | 1.165*** | -.783*** | -2.425*** | -1.548*** |
| | (.179) | (.502) | (.281) | (.233) | (.658) | (.385) |
| Controls and constant | YES | YES | YES | YES | YES | YES |
| Obs. | 1316 | 1316 | 1316 | 1315 | 1315 | 1315 |
| Groups | 37 | 37 | 37 | 37 | 37 | 37 |
| Log likehood | -389.338 | -385.345 | -384.699 | -207.553 | -204.450 | -205.336 |

Notes: standard errors in parenthesis, * **significant at 1%, ** significant al 5%, *significant at 10%.

The results as presented in table 4 are somehow puzzled. The coefficients associated with MUV index and the manufacture exports are statistically significant in every column. However, an increase in the MUV index and manufacture exports increase the probability of an internal conflict and it decreases the probability of an internationalized conflict. Nonetheless, as these variables are interacted, the marginal effects represent the real effect of these variables on armed conflicts. In the case of internal civil war, different commodity prices indexes appear to be negatively associated with the probability of an internal civil war. Put differently, shocks in oil or metals prices should not be blamed to inflame internal conflicts. By contrast, they are positively associated with the likelihood of an internationalized civil war. In other words, whenever the oil price increases the probability a Sub-Saharan country experiences an internal war decreases. We need to compute the marginal effects of commodity prices, as they are interacted with the oil exporter dummy.

Table 5 – Marginal effects of Table 4

| | Internal Conflict | Internationalized conflict |
|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| (Log) MUV [(Log) manuf. (5th percentile)] | 2.733*** | 4.426*** | 4.408*** | -3.401*** | -4.672*** | -4.298*** |
| | (.864) | (.985) | (.961) | (1.089) | (1.220) | (1.248) |
| (Log) MUV [(Log) manuf. (10th percentile)] | 2.122*** | 3.731*** | 3.706*** | -2.409*** | -3.522*** | -2.936*** |
| | (.694) | (.820) | (.798) | (.884) | (1.028) | (1.046) |
| (Log) MUV [(Log) manuf. (20th percentile)] | 1.614*** | 3.154*** | 3.125*** | -1.589** | -2.571*** | -1.810** |
| | (.574) | (.712) | (.687) | (.752) | (.922) | (.924) |
| (Log) MUV [(Log) manuf. (40th percentile)] | .914* | 2.358*** | 2.322*** | -.454 | -1.257 | -.252 |
| | (.473) | (.631) | (.599) | (.668) | (.889) | (.858) |
| (Log) MUV [(Log) manuf. (60th percentile)] | .206 | 1.553*** | 1.510** | .696 | .077 | 1.328 |
| | (.488) | (.656) | (.613) | (.733) | (.999) | (.933) |
| (Log) MUV [(Log) manuf. (80th percentile)] | -.395 | .870 | .822 | 1.672* | 1.207 | 2.668** |
| | (.588) | (.753) | (.703) | (.885) | (1.176) | (1.089) |
| (Log) Manufacturing Share of GDP | -.112 | -.049 | -.082 | -.232** | -.296** | -.198* |
| | (.078) | (.081) | (.079) | (.117) | (.126) | (.119) |
| (Log) OIL price index | -.357*** | | | .272 | | |
| | (.109) | | | (.167) | | |
| (Log) Non fuel price index | | -1.664*** | | | 1.169** | |
| | | (.381) | | | (.558) | |
| (Log) Metals price index | | | -.962*** | | | .105 |
| | | | (.209) | | | (.301) |
| Oil exporter (dummy) | .352 | .348 | .348 | 1.127** | 1.213* | .996 |
| | (.426) | (.433) | (.428) | (.568) | (.623) | (.595) |

Notes: standard errors in parenthesis, * **significant at 1%, ** significant al 5%, *significant at 10%. all variables are logged.

Table 5 shows the marginal effects of some variables in Table 4. There are just a few positive observations of conflicts above the 40$^{th}$ percentile of the logarithm of manufactures exports. Therefore, we introduce the 5$^{th}$ and the 10$^{th}$ percentiles (countries like Gambia and Equatorial Guinea) in order to have a wider range for positive observations of conflicts. Regarding internal conflicts, it is clear that a higher MUV index increases the probability of

such conflicts in countries whose manufacture exports are below the 80th percentile, like Nigeria, South Africa or Cameroon. In countries like Gambia and Equatorial Guinea, a 1% increase in the MUV index generates approximately a 3.5% increase in the probability of an internal conflict. However, a greater manufacturing share of GDP does not have any effect on internal conflicts. Finally, a 1% increase in commodity prices affect negatively the probability of internal conflicts. Concerning internationalized conflicts, a 1% increase in the MUV index affects differently to the probability of conflicts in countries, depending on the manufacture exports of such countries.

This increase generates approximately a 3% decrease in the probability of an internationalized conflict in countries whose manufacture exports are in the 20th percentile, like Gambia or Sierra Leone (low values of manufacture exports). However, when the MUV index increases, the probability of conflict is approximately 2% higher in countries in the 80th percentile, like Nigeria and South Africa (great values of manufacture exports). Besides, a greater manufacturing share of GDP is negatively related to such conflicts. Finally, only an increase in the non-fuel price index affect positively to the probability of an internationalized conflict. To summarize, main results highlight that: (i) Among commodities, the MUV price index has a positive association with the likelihood of a internal conflict and the likelihood of an internationalized conflict in countries with great values of manufacture exports. (ii) Oil price index and metals index show a negative association with the likelihood of a internal conflict; (iii) A greater manufacturing share of GDP and a greater MUV index presents a significant negative association with the likelihood of a internationalized conflict in countries below the 20th percentile.

## VI. Robustness checks

*(i) The period 1980-2001*

According to previous estimations, there is evidence that the international price of manufactures has a negative association with arms imports, military expenditures and the incidence of an internationalized conflict. However, an increase in the MUV index is associated with a greater probability of an internal civil war. Besides, it is clear that commodity prices have a positive effect on arms imports, military expenditures and the probability of an internationalized conflict. Meanwhile, higher commodity prices are negatively related to the incidence of an internal conflict. In order to give robustness to these results, we try to estimate our model by splitting the time series into two sub-periods: 1980-2001 and 2002-2017. In fact, we select 2001 taking the September 11th attack in New York as turning point.

Table 6 – Arms import, Military expenditures and international prices 1980-2001

| | Arms import | | | Military Expenditures | | |
|---|---|---|---|---|---|---|
| (Log) OIL price index Lagged | .172 | | | .022 | | |
| | (.315) | | | (.103) | | |
| (Log) Non fuel price index Lagged | | 1.133 | | | -.108 | |
| | | (1.326) | | | (.403) | |
| (Log) metals price index Lagged | | | .639 | | | .188 |
| | | | (.495) | | | (.142) |
| (Log) MUV Lagged | 2.592 | 1.419 | 1.411 | -.922 | -.834 | -1.029 |
| | (1.694) | (1.751) | (1.730) | (.823) | (.973) | (.828) |
| (Log) Manufacture Exports Lagged (millions) | 4.459** | 4.391** | 4.355** | .592 | .580 | .616 |
| | (1.859) | (1.843) | (1.839) | (.691) | (.682) | (.694) |
| MUV * Manufacture Exports Lagged | -.997** | -988** | -.979** | -.127 | -.123 | -.134 |
| | (.412) | (.409) | (.407) | (.154) | (.152) | (.156) |
| (Log) Agricultural Share of GDP | .279 | .248 | .249 | -.630* | -.627* | -.630* |
| | (.428) | (.434) | (.426) | (.351) | (.349) | (.347) |
| Controls and constant | YES | YES | YES | YES | YES | YES |
| Obs. | 347 | 347 | 347 | 383 | 383 | 383 |
| Groups | 37 | 37 | 37 | 35 | 35 | 35 |
| R-sq within | .0955 | .0974 | .0989 | .1585 | .1587 | .1631 |
| R-sq between | .0117 | .1958 | .1531 | .6279 | .6331 | .6000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| R-sq overall | .0145 | .0807 | .0673 | .6232 | .6296 | .5923 |

Notes: standard errors in parenthesis, * **significant at 1%, ** significant al 5%, *significant at 10%.

Table 6 above reports the results. In this case, commodity prices do not have any effect on arms imports and military expenditures. By contrast, there is negative association between the agricultural share of the GDP and military expenditures. As MUV and the manufacture exports are interacted with each other, we need to compute the marginal effects in order to see the relationship between these variables and dependent variables.

Table 7 – Marginal effects of Table 6

| | Arms import | | | Military Expenditures | | |
|---|---|---|---|---|---|---|
| (Log) MUV [(Log) manuf. (20th percentile)] | .037 | -1.112 | -1.096 | -.1.246** | -1.148 | -1.371** |
| | (1.070) | (1.332) | (1.159) | (.540) | (.782) | (.572) |
| (Log) MUV [(Log) manuf. (40th percentile)] | -1.026 | -2.165 | -2.139* | -1.343*** | -1.243* | -1.473*** |
| | (1.041) | (1.373) | (1.140) | (.486) | (.754) | (.530) |
| (Log) MUV [(Log) manuf. (60th percentile)] | -2.186* | -3.314** | -3.277** | -1.469*** | -1.366* | -1.606*** |
| | (1.207) | (1.562) | (1.296) | (.454) | (.745) | (.512) |
| (Log) MUV [(Log) manuf. (80th percentile)] | -2.914** | -4.036** | -3.991*** | -1.589*** | -1.483* | -1.733*** |
| | (1.388) | (1.738) | (1.465) | (.471) | (.765) | (.539) |
| (Log) Manufacture Exports (millions) | .023 | -.003 | .002 | .013 | .017 | .004 |
| | (.152) | (.164) | (.153) | (.100) | (.099) | (.098) |

Notes: standard errors in parenthesis, * **significant at 1%, ** significant al 5%, *significant at 10%.

Table 7 shows the marginal effects of the MUV index and the manufacture exports variables in Table 6. Comparing with Table 3, results are very robust. We can observe that a 1% increase of the MUV index keeps being negatively related to arms imports and the military expenditures, generating a 3% reduction in arms imports and a 1.5% decrease in military expenditures, approximately.

Table 8– Conflict and international prices – 1980-2001

| | Internal Conflict | | | Internationalized conflict | | |
|---|---|---|---|---|---|---|
| (Log) OIL price index Lagged | .749* | | | -.111 | | |
| | (.407) | | | (.634) | | |
| (Log) Non fuel price index Lagged | | -3.346*** | | | 5.440*** | |
| | | (1.227) | | | (1.999) | |
| (Log) metals price index Lagged | | | -1.513** | | | 3.266*** |
| | | | (.646) | | | (1.046) |
| (Log) MUV Lagged | 10.355*** | 11.185*** | 10.625*** | -1.759 | -3.252 | -4.315* |
| | (1.754) | (1.892) | (1.799) | (2.280) | (2.100) | (2.313) |
| (Log) Manufacture Exports Lagged (millions) | 8.811*** | 9.999*** | 9.531*** | .061*** | -.669 | -1.698 |
| | (1.863) | (1.989) | (1.921) | (2.601) | (2.495) | (2.619) |
| MUV * Manufacture Exports Lagged | -1.971*** | -2.211*** | -2.118*** | -1.004 | .025*** | .269 |
| | (.412) | (.438) | (.424) | (.588) | (.563) | (.591) |
| (Log) Agricultural Share of GDP | .273 | .447 | .348 | .755 | .598 | .723 |
| | (.321) | (.336) | (.329) | (.498) | (.512) | (.529) |
| Oil exporter (dummy) | 1.106 | -17.253** | -8.373** | .793 | 22.459** | 15.754*** |
| | (2.174) | (8.162) | (3.908) | (3.031) | (11.449) | (5.764) |
| Commodity Price Lagged * Oil exporter | -.347 | 3.803** | 1.982*** | .144*** | -4.671* | -3.456** |
| | (.569) | (1.813) | (.934) | (.780) | (2.536) | (1.378) |
| Controls and constant | YES | YES | YES | YES | YES | YES |
| Obs. | 744 | 744 | 744 | 744 | 744 | 744 |
| Groups | 37 | 37 | 37 | 37 | 37 | 37 |
| Log likehood | -220.244 | -217.849 | -218.636 | -106.427 | -102.405 | -100.900 |

Notes: standard errors in parenthesis, * **significant at 1%, ** significant al 5%, *significant at 10%.

In Table 8, where dependent variables are internal and internationalized conflicts, the coefficients associated with MUV index and the manufacture exports are positively and significantly related to the incidence of internal conflicts. We compute the marginal effects of the MUV and manufacture exports, along with commodity prices, as they are interacted with the oil exporter dummy.

Table 9 – Marginal effects of Table 8

| | Internal Conflict | | | Internationalized conflict | | |
|---|---|---|---|---|---|---|
| (Log) MUV [(Log) manuf. (5th percentile)] | 9.406*** | 9.716*** | 9.217*** | -1.825 | -3.236* | -4.137** |
| | (1.522) | (1.633) | (1.553) | (1.963) | (1.797) | (1.995) |
| (Log) MUV [(Log) manuf. (10th percentile)] | 7.091*** | 7.523*** | 7.116*** | -1.925 | -3.212** | -3.870** |
| | (1.209) | (1.274) | (1.215) | (1.553) | (1.409) | (1.583) |
| (Log) MUV [(Log) manuf. (20th percentile)] | 5.722*** | 5.987*** | 5.645*** | -1.995 | -3.195*** | -3.683*** |
| | (1.031) | (1.057) | (1.015) | (1.345) | (1.219) | (1.372) |
| (Log) MUV [(Log) manuf. (40th percentile)] | 4.183*** | 4.260*** | 3.990*** | -2.073* | -3.175*** | -3.474*** |
| | (.899) | (.877) | (.858) | (1.236) | (1.135) | (1.258) |
| (Log) MUV [(Log) manuf. (60th percentile)] | 2.212** | 2.050** | 1.873** | -2.174 | -3.151** | -3.205** |
| | (.885) | (.815) | (.824) | (1.336) | (1.264) | (1.350) |
| (Log) MUV [(Log) manuf. (80th percentile)] | .203 | -.204 | -.287 | -2.276 | -3.126* | -2.931* |
| | (1.053) | (.976) | (.996) | (.885) | (1.602) | (1.670) |
| (Log) Manufacture Exports (millions) | -.022 | .090 | .038 | -.389** | -.559*** | -.494*** |
| | (.111) | (.118) | (.114) | (.173) | (.193) | (.189) |
| (Log) OIL price index | .631* | | | -.062 | | |
| | (.355) | | | (.509) | | |
| (Log) Non fuel price index | | -2.058** | | | 3.858** | |
| | | (1.027) | | | (1.557) | |
| (Log) Metals price index | | | -.842 | | | 2.095** |
| | | | (.539) | | | (.838) |
| Oil exporter (dummy) | -.168 | -.202 | -.192 | 1.322* | 1.515** | 1.486** |
| | (.566) | (.587) | (.428) | (.708) | (.736) | (.755) |

Notes: standard errors in parenthesis, * **significant at 1%, ** significant al 5%, *significant at 10%.; all variables are logged.

Table 9 shows the marginal effects of some variables in Table 8. Comparing with Table 5, results are very robust: a 1% increase in the MUV index increases the probability of internal conflicts, even reaching a 9% increase in this probability in countries with low exports, and decreases the

probability of internationalized conflicts, approximately a 3% decrease. Meanwhile, an increase in the oil price index affects positively to internal conflicts, while the non-fuel price index has the opposite effect on internal conflicts.

*(ii) The period 2002 - 2017*

We now estimate our model for the 2002-2017 period. Results are presented in table 10.

Table 10 – Arms import, Military expenditures and international prices

| | Arms import | | | Military Expenditures | | |
|---|---|---|---|---|---|---|
| (Log) OIL price index Lagged | -1.001 | | | .253 | | |
| | (.805) | | | (.170) | | |
| (Log) Non fuel price index Lagged | | -.319 | | | .489* | |
| | | (1.221) | | | (.248) | |
| (Log) metals price index Lagged | | | .279 | | | .166 |
| | | | (.403) | | | (.101) |
| (Log) MUV Lagged | 3.101 | -.133 | -2.597 | .432 | .270 | .639 |
| | (4.501) | (4.970) | (3.601) | (.999) | (.800) | (.909) |
| (Log) Manufacture Exports Lagged (millions) | -3.372* | -3.312* | -3.565* | .422 | .444 | .359 |
| | (1.794) | (1.892) | (1.899) | (.834) | (.825) | (.813) |
| MUV * Manufacture Exports Lagged | .681* | .655 | .698* | -.106 | -.114 | -.093 |
| | (.374) | (.389) | (.395) | (.180) | (.180) | (.176) |
| (Log) Agricultural Share of GDP | -.630 | -.672 | -.694 | -.112 | -.129 | -.136 |
| | (.489) | (.474) | (.480) | (.118) | (.121) | (.123) |
| Controls and constant | YES | YES | YES | YES | YES | YES |
| Obs. | 286 | 286 | 286 | 495 | 495 | 495 |
| Groups | 35 | 35 | 35 | 37 | 37 | 37 |
| R-sq within | .0618 | .0541 | .0550 | .3596 | .3656 | .3599 |
| R-sq between | .0932 | .0966 | .0268 | .2532 | .2474 | .2590 |
| R-sq overall | .0272 | .0297 | .0033 | .3115 | .3008 | .3130 |

Notes: standard errors in parenthesis, * **significant at 1%, ** significant al 5%, *significant at 10%.

It appears that commodity prices do not have any effect on arms imports and military expenditures. By contrast, there is negative association between the agricultural share of the GDP and military expenditures. As MUV and the manufacture exports are interacted with each other, we need to compute the marginal effects that are presented in table 11.

Table 11 – Marginal effects of Table 10

| | Arms import | | | Military Expenditures | | |
|---|---|---|---|---|---|---|
| (Log) MUV [(Log) manuf. (20th percentile)] | 5.969 | 2.622 | .343 | .051 | -1.393 | .306 |
| | (3.8) | (3.858) | (2.699) | (.557) | (.434) | (.498) |
| (Log) MUV [(Log) manuf. (40th percentile)] | 6.593* | 3.222 | .983 | -.075 | -.275 | .195 |
| | (3.716) | (3.668) | (2.212) | (.516) | (.472) | (.480) |
| (Log) MUV [(Log) manuf. (60th percentile)] | 7.905* | 3.705 | 1.498 | -.155 | -.360 | .126 |
| | (3.671) | (3.534) | (2.099) | (.534) | (.540) | (.515) |
| (Log) MUV [(Log) manuf. (80th percentile)] | 7.497** | 4.901 | 1.910 | -.236 | -.447 | .055 |
| | (3.649) | (3.440) | (2.034) | (.585) | (.631) | (.579) |
| (Log) Manufacture Exports (millions) | -.174 | -.239* | -.287** | -.075 | -.090 | -.075 |
| | (.141) | (.144) | (.129) | (.143) | (.144) | (.140) |

Notes: standard errors in parenthesis, * **significant at 1%, ** significant al 5%, *significant at 10%.

We can observe that an increase in the MUV index affects arms imports positively.

Table 12– Conflict and international prices – Main results

| | Internal Conflict | | | Internationalized conflict | | |
|---|---|---|---|---|---|---|
| (Log) OIL price index Lagged | 1.407* | | | 1.547 | | |
| | (.799) | | | (1.154) | | |
| (Log) Non fuel price index Lagged | | -.657 | | | .280 | |
| | | (1.029) | | | (1.299) | |
| (Log) metals price index Lagged | | | -.200 | | | -.547 |
| | | | (.485) | | | (.647) |

| | | | | | | |
|---|---|---|---|---|---|---|
| (Log) MUV Lagged | -12.956*** | -6.162* | -6.799** | -9.964* | -3.286 | -.428 |
| | (4.199) | (3.303) | (3.132) | (6.051) | (4.817) | (4.533) |
| (Log) Manufacture Exports Lagged (millions) | -5.691** | -6.815*** | -6.795*** | -11.965*** | -8.956** | -6.492 |
| | (2.370) | (2.375) | (2.358) | (4.557) | (4.297) | (4.243) |
| MUV * Manufacture Exports Lagged | 1.165** | 1.421*** | 1.415** | 2.549*** | 1.920** | 1.400 |
| | (.511) | (.513) | (.509) | (.965) | (.908) | (.894) |
| (Log) Agricultural Share of GDP | .018 | .092 | .091 | -.139 | -.046 | .013 |
| | (.286) | (.283) | (.281) | (.551) | (.479) | (.465) |
| Oil exporter (dummy) | .148 | 2.052 | 2.174 | 14.395*** | 15.712** | 7.750* |
| | (1.876) | (3.427) | (3.908) | (4.322) | (6.299) | (3.968) |
| Commodity Price Lagged * Oil exporter | .195 | -.221 | -.248 | -2.569*** | -2.929** | -1.353* |
| | (.385) | (.708) | (.444) | (.795) | (1.234) | (.770) |
| Controls and constant | YES | YES | YES | YES | YES | YES |
| Obs. | 572 | 572 | 572 | 571 | 571 | 571 |
| Groups | 37 | 37 | 37 | 37 | 37 | 37 |
| Log likehood | -139.084 | -140.643 | -140.510 | -71.820 | -75.225 | -74.675 |

Notes: standard errors in parenthesis, * **significant at 1%, ** significant al 5%, *significant at 10%. For sake of readability statistically significant coefficients are in bold.

In Table 12, we show the results of the probit model where the dependent variables are internal and internationalized conflicts. The coefficients associated with MUV index and the manufacture exports are negatively and significantly related to the incidence of internal conflicts. We compute the marginal effects of these variables, along with the marginal effects of commodity prices, as they are interacted with the oil exporter dummy.

Table 13 – Marginal effects of Table 12

| | Internal Conflict | | | Internationalized conflict | | |
|---|---|---|---|---|---|---|
| (Log) MUV [(Log) manuf. (5th percentile)] | -11.251*** | -4.082 | -4.727* | -6.233 | -1.015 | 1.621 |
| | (3.835) | (2.819) | (2.524) | (5.276) | (3.878) | (3.464) |

| | | | | | | |
|---|---|---|---|---|---|---|
| (Log) MUV [(Log) manuf. (10th percentile)] | -10.512*** | -3.181 | -3.829* | -4.616 | .203 | 2.509 |
| | (3.713) | (2.648) | (2.286) | (5.027) | (1.409) | (3.059) |
| (Log) MUV [(Log) manuf. (20th percentile)] | -9.144*** | -1.512 | -2.167 | -1.622 | 2.458 | 4.153* |
| | (3.555) | (2.416) | (1.911) | (4.744) | (3.135) | (2.483) |
| (Log) MUV [(Log) manuf. (40th percentile)] | -7.558** | .422 | -.241 | 1.849 | 5.074* | 6.060*** |
| | (3.493) | (2.320) | (1.650) | (4.745) | (3.076) | (2.286) |
| (Log) MUV [(Log) manuf. (60th percentile)] | -6.637* | 1.545 | .878 | 3.862 | 6.590** | 7.165*** |
| | (3.520) | (2.36) | (1.620) | (4.909) | (3.264) | (2.458) |
| (Log) MUV [(Log) manuf. (80th percentile)] | -5.721 | 2.662 | 1.991 | 5.867 | 8.100** | 8.266*** |
| | (3.593) | (2.466) | (1.688) | (5.180) | (3.586) | (2.800) |
| (Log) Manufacture Exports (millions) | -.248* | -.176 | -.181 | -.054 | .017 | .050 |
| | (.150) | (.150) | (.149) | (.298) | (.193) | (.272) |
| (Log) OIL price index | 1.472* | | | -.062 | | |
| | (.788) | | | (.509) | | |
| (Log) Non fuel price index | | -.731 | | | -.700 | |
| | | (.982) | | | (1.210) | |
| (Log) Metals price index | | | -.238 | | | -.999* |
| | | | (.430) | | | (.565) |
| Oil exporter (dummy) | 1.085** | .981** | .973** | 2.016* | 1.514 | 1.195 |
| | (.432) | (.423) | (.421) | (1.096) | (.927) | (.856) |

Notes: standard errors in parenthesis, * **significant at 1%, ** significant al 5%, *significant at 10%. all variables are logged.

Table 13 shows the marginal effects of some variables in Table 12. In this case, a higher MUV index decreases the probability of internal conflicts, while it increases the probability of an internationalized conflict. Commodity prices do not have any effect on the probability of such conflicts, except for the oil price index (it affects positively to internal conflicts) and the metal's price index (it affects negatively to the probability of an internationalized conflict). Therefore, results are not very robust in comparison to the estimations on internal and internationalized conflicts for the 1980-2017 period.

*(iii) Agriculture*

As further estimation, we focus on agriculture by including the agricultural raw price, instead of the MUV index, in order to see its association on military expenditures, the acquisition of arms, internal and internationalized conflicts. In brief, we want to deepen whether agricultural production is to be related to conflict because it is a productive activity which could be categorized either as 'contested' or 'uncontested'. In fact, we are substituting the manufacturing sector with agriculture under the implicit assumption that agriculture could be the 'uncontested' sector. In previous estimations we have included the agricultural share of GDP only which has provided mixed and weak evidence. In what follows we therefore include the agricultural raw price and we also interact it with the agricultural share of gdp. Speculalry, we include the manufacturing share of GDP as control. Then, we estimate the fixed effects panel OLS models:

$$milex_{it} = \beta_0 + \beta_1 Agrprice_{it-1} + \beta_2 Agrshare_{it-1} + X_{it} + u_{it}$$

and eventually the panel probit model

$$civilwar_{it} = \beta_0 + \beta_1 Agrprice_{it-1} + \beta_2 Agrshare_{it-1} + X_{it} + u_{it}$$

Table 14 – Arms import, Military expenditures and conflicts

| | Arms import | Military expenditures | Internal conflict | Internationalized conflict |
|---|---|---|---|---|
| (Log) Agricultural raw price Lagged | -1.626** | -.228 | -2.534** | -.4.341** |
| | (.738) | (.600) | (1.224) | (1.907) |
| (Log) Agricultural share of GDP Lagged | -1.305 | -.656 | -3.155* | -5.643** |
| | (1.026) | (.932) | (1.652) | (2.578) |
| (Log) Agricultural price * (Log) | .250 | .077 | .791** | 1.385** |

| | | | | |
|---|---|---|---|---|
| Agricultural share Lagged | | | | |
| | (.222) | (.197) | (.353) | (.554) |
| (Log) Manufacturing Share of GDP | .116 | -.072 | .083 | .591** |
| | (.119) | (.175) | (.126) | (.232) |
| Oil exporter (dummy) | | | .188 | .575 |
| | | | (.386) | (.599) |
| Oil exporting - years | -.002 | .018* | | |
| | (.018) | (.009) | | |
| Controls and constant | YES | YES | YES | YES |
| Obs. | 661 | 911 | 1392 | 1391 |
| Groups | 40 | 40 | 40 | 40 |
| Log likelihood | | | -443.016 | -232.918 |
| R-sq within | .0276 | .4419 | | |
| R-sq between | .1987 | .3834 | | |
| R-sq overall | .0953 | .4217 | | |

Notes: standard errors in parenthesis, * **significant at 1%, ** significant al 5%, *significant at 10%.
For sake of readability statistically significant coefficients are in bold;

Table 14 above reports the results. An increase in the agricultural raw price is associated with a reduction of arms imports and it decreases the probability of an internationalized conflict. Also in his case, we compute the marginal effects of the agricultural raw price and the agricultural share of GDP in order to see their effect on dependent variables.

Table 15 – Marginal effects of Table 14

| | Arms imports | Military expenditures | Internal conflict | Internationalized conflict |
|---|---|---|---|---|
| (Log) Agr. raw price [(Log) agr. Share (5th percentile)] | -1.336** | -.130 | -1.452* | -2.445** |
| | (.554) | (.360) | (.760) | (1.176) |
| (Log) Agr. raw price [(Log) agr. Share (10th percentile)] | -1.250** | -.095 | -1.113* | -1.851* |
| | (.512) | (.280) | (.621) | (.956) |
| (Log) Agr. raw price [(Log) agr. Share (20th percentile)] | -1.070** | -.038 | -.505 | -.787** |
| | (.453) | (.165) | (.394) | (.594) |

| | | | | |
|---|---|---|---|---|
| (Log) Agr. raw price [(Log) agr. Share (40th percentile)] | -.856* | .016 | -.008 | .085 |
| | (.452) | (.138) | (.276) | (.404) |
| (Log) Agr. raw price [(Log) agr. Share (60th percentile)] | -.763 | .040 | .253 | .541 |
| | (.475) | (.165) | (.273) | (.4) |
| (Log) Agr. raw price [(Log) agr. Share (80th percentile)] | -.703 | .057 | .442 | .872* |
| | (.498) | (.194) | (.3) | (.448) |
| (Log) Agricultural Share of GDP | -.161 | -.295* | .474*** | .716*** |
| | (.361) | (.152) | (.182) | (.275) |

Notes: standard errors in parenthesis, * **significant at 1%, ** significant al 5%, *significant at 10%.

Table 15 shows the marginal effects of the agricultural raw price and the agricultural share of GDP. We distinguish between countries with very low share, like Botswana or South Africa; shares close to the mean, like Angola or Senegal, and countries with very high shares, like Somalia or Democratic Republic of Congo. It is clear that a 1% increase in the agricultural raw price generates a decrease in arms imports, approximately a 1% decrease in countries below the 40$^{th}$ percentile. Meanwhile, a 1% increase in the agricultural raw price generates, approximately, a 2% decrease in the probability of internationalized conflicts in countries with a low agricultural share of GDP like Botswana or South Africa (below the 20$^{th}$ percentile). Besides, a greater agricultural share of GDP is negatively related to military expenditures and positively related to the probability of both conflicts.

## Conclusion

The paper presents first a theoretical enrichment of economic analysis of conflict and eventually an empirical section focused on Sub-saharan Africa for the period 1980-2017. That is, this paper has presented first a theoretical model of conflict between two parties in a two-sector economy. Following Caruso (2010), economies are interpreted as being divided into

contested and uncontested productions. In a 'contested' sector, they struggle to appropriate the maximum possible fraction of a contestable output. In an 'uncontested' sector, they hold secure property rights over the production of some goods. In this context, parties split their resource endowment between 'butter', 'guns' and 'ice cream' where the latter denote the resources allocated to the sector which is not subject to conflict. The parties face exogenous prices for both sectors. The model predicts that the optimal level of guns depends positively on the relative price of contested resources. In brief, as the relative price between butter and ice-cream decreases actors decrease their outlays in 'guns'.

Eventually we present an empirical application to the Sub-Saharan Africa for the period 1980-2017. In particular, in order to test empirically the theoretical predictions, we take into account as dependent variables alternatively the arms import and the military spending. Wo test whether there is an association between world prices and both dependent variables. In particular, we consider the world prices of some commodities and the world price of manufactured goods captured through the MUV index produced by World Bank. Results show that international prices of manufactures are negatively associated with arms import and military expenditure so confirming the theoretical prediction. For sake of robustness we have split the time period into two sub-periods. We found that the 1980-2001 period is very robust with results obtained for the 1980-2017 period, but the 2002-2017 period evidence is less robust.

In addition, we have checked whether the commodity prices and the economic structure has an impact on the probability of emergence of an armed conflict by means of a probit model. In particular, we used the two types of conflict (internal and internationalized), as coded by the UCDP dataset. A higher international price index for manufactures is associated with a higher probability of an internal civil war, and a lower probability of an internationalized civil war. By contrast, there is robust evidence about a negative association between commodity prices and the probability of an

internal civil war. Yet, in another alternative estimation, we found that agricultural prices are negatively related to the probability of a civil war in countries with a low agricultural share of the GDP, while such prices affect positively the probability of an internal conflict in countries with a moderately high agricultural share of the GDP.

This study appears to be nothing but an interesting contribution to the existing literature. In fact, the topic is relevant nowadays when the new geography of trade is likely to induce in the next future a downward pressure on prices of several categories of manufactures. In many developing countries, in the presence of low prices for low-tech manufactures, the relative profitability of contested production would increase thereby fueling the emergence of actual conflicts. Yet these results appear to be worrisome also in the light of results proposed by Rodrik (2016) that shows that nowadays countries are running out of industrialization at lower levels of income compared to the early industrializers. In simpler words, developing economies are becoming less industrialized at a faster pace than highly developed economies.

Consequently, this also poses an intriguing question in terms of policy prescriptions. In fact, enhancing protectionism to raise prices of manufactures would also build systems of rents, which may be even counterproductive by plausibly fueling other conflicts. Therefore, the question is open and this work is nothing but an intriguing spare part of a broader and more complex work.

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Appendix

Table 16: Descriptive statistics of control variables

| Variable | Obs. | Mean | Std. Dev | Min | Max | Source of data |
|---|---|---|---|---|---|---|
| (Log) OIL price index | 1567 | 4.24 | 0.75 | 3.20 | 5.54 | IMF |
| (Log) Non fuel price index | 1567 | 4.67 | 0.29 | 4.33 | 5.25 | IMF |
| (Log) Metals price index | 1567 | 4.47 | 0.50 | 3.87 | 5.44 | IMF |
| (Log) Agricultural raw price | 1567 | 4.60 | 0.23 | 4.11 | 5.04 | IMF |
| (Log) MUV | 1567 | 4.58 | 0.17 | 4.25 | 4.83 | World Bank |
| (Log) Manufactures | 1376 | 4.22 | 1.95 | -2.22 | 9.59 | World Bank |
| (Log) Agricultural share of GDP | 1458 | 3.13 | 0.81 | 0.04 | 4.39 | World Bank |
| (Log) Manufacturing share of GDP | 1458 | 2.12 | 0.76 | -3.47 | 3.73 | World Bank |
| (Log) Openness | 1529 | 3.99 | 0.71 | 0.15 | 5.26 | World Bank |
| Polity | 1537 | -1.56 | 8.53 | -77 | 9 | Center for Systemic Peace |
| (Log) Population | 1560 | 8.97 | 1.25 | 5.52 | 12.19 | World Bank |
| Oil exporter (dummy) | 1567 | 0.35 | 0.48 | 0 | 1 | United Nations |
| Landlocked (dummy) | 1567 | 0.37 | 0.48 | 0 | 1 | World Bank |
| Oil exporting (trend) | 1567 | 2.97 | 7.07 | 0 | 33 | United Nations |

Table 17: Sub-Saharian African Countries by deciles of income in 2000 (real GDP per capita)

| **Decile** | **Value** | **Countries** |
|---|---|---|
| $10^{th}$ | 437.30 | Democratic Republic of Congo, Burundi, Zimbabwe, Ethiopia, Mozambique |
| $20^{th}$ | 605.94 | Somalia, Malawi, Sierra Leone, Liberia, Central African Republic |
| $30^{th}$ | 632.75 | Rwanda |

| | | |
|---|---|---|
| 40th | 799.60 | Tanzania, Chad, Mali, Burkina Faso, Togo, Guinea |
| 50th | 973.49 | Eritrea, Uganda, Zambia |
| 60th | 1112.50 | Lesotho, Benin, Nigeria, Kenya |
| 70th | 1462.36 | Gambia, Senegal, Sudan |
| 80th | 1636.18 | Ivory Coast, Ghana, Mauritania, Cameroon |
| 90th | 3636.43 | Congo, Angola, Swaziland, Namibia, Niger |
| 100th | 10880.58 | South Africa, Equatorial Guinea, Botswana,Gabon |